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Pre-service teachers' attitudes towards teaching of evolution theory

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Abstract

Evolution theory is one of the most debate topics in science teaching because the theory doesn't clarify diversity of livings, similarities and differences amid livings physical, chemical and biological changes of the world. The study aims to introduce "Teaching Evolution Theory Attitude Questionnaire" developed by researcher. Validity and Reliability of the Questionary was carried out with 273 preservice teachers, 152 male and 121 females. 5. Point likert type scale, having 30 items, which is composed for this purpose, was used as the assessment instrument. Collecting data were analyzed with SPSS program and validity and form of scale was examined with factor analysis. Consequently, it has been confirmed that the scale may be used confidently to determine attitudes toward teaching of Evolution Theory.

Keywords: Creation theory; evolution theory; teaching evolution.

1. Introduction

TOE (theory of evolution) is one of the most significant issues of living science because evolution theory is the most potent scientific instruction to associate all livings in universe. While Dobzhansky (1973) state that the evolution theory generate base of modern science, Gould (1982) liken biology teaching, having no evolution theory, to Chemical having no periodic table. Besides Bishop and Anderson (1990) affirm that it is not possible to comprehend Biology without perceiving TOE.

According to Demirsoy (1991), evolution is a disciplinary which analyzes formation of genus, and changes that they have faced throughout life, and are those they are still facing. In other words, it is variation in periodicity of families forming gene of a population.

As to Ertan (2007) evaluation is not an incident which occurred and ended in history but it is a fact that shape whole universe, world, nature and life. It is a concept harmonizing, uniting of numerous knowledge obtained from science of nature. In respect of this view, evolution acts as roof which keeps Biological knowledge in united form.

A great number of questions, without mentioning the evolution, can be answered with knowledge of various scopes, such as Genetic, Physiology, Cytology, Anatomy, and Molecular Biology. However universal approach is a necessity to answer qualitative answers about how incidents take place. Nevertheless, students seem to have some

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difficulties in perceiving evolution theory, learning and in accepting evolution theory as theory of Biology (Bishop and Anderson 1990; Settlage 1994; Sinclair and Baldwin 1997).

The studies have revealed that students have poor understanding regarding to TOE, it is because students have some deficiencies to comprehend the difference between scientific and non-scientific knowledge, content knowledge of theory besides concepts such as theory, law, and hypothesis, linked to nature of science (Baker Piburn 1997; Lawson 1995). According to Bloom's study (1989) over teachers' candidate of science towards science, theory, evolution, participants indicated that participants have crucial concept errors. He stated how these errors and beliefs affect participants' comprehension of science, of their approach to TOE, of the way they plan to study TOE. Studies by Bakanay and İrez (2009) over theory of science and evolution indicated that pre-service teachers of Biology have negative attitudes towards TOE. Findings reveal that acceptance of candidate teachers regarding TOE is low according to Apaydın and Sürmeli (2009). Teachers tend to impose their own views during teaching process (Blackwell and ark. (2003). It is clear that numerous studies, related to attitudes of Biology teachers' have been conducted. However, the numbers of studies over Primary level are inadequate. Hence, the present study aims at investigating the attitudes of pre-service teachers towards TOE. For this purpose, a scale for attitudes of pre-service teachers towards TOE' was developed.

2. Method

2.1. Participant

Participants selected from two different universities in Turkey in 2009. Totaly 273 male and female preservice teachers participated in this study. The numbers of male and female preservice teachers were 152 and 121, respectively. All participants were from various grades in faculty of education of the selected universities. The students were studying to become a teacher in the area of elementary education.

2.2. Development process of teaching evolution theory attitude questionnaire (TETAQ)

In order to develop Teaching Evolution Theory Attitude Questionnaire (TETAQ), eight-step model, illustrated in Fig. 1, was used (Erdoğan and all, 2009).

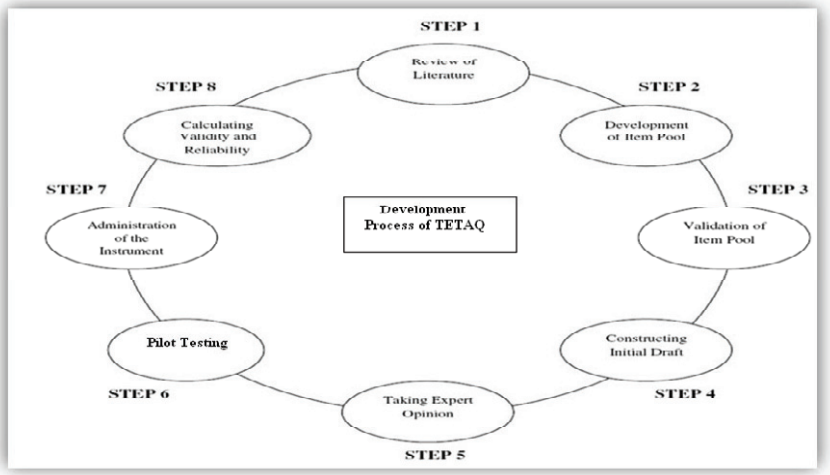

Figure 1. Teaching Evolution Theory Attitude Questionnaire (TETAQ), eight-step model

Step 1. Review of literature

In the first step of the instrument development, a comprehensive review of literature was conducted in an attempt to identify the existing instruments available in the literature. A pool of possible assessment items were related to the attitude toward evolution theory. Researchers selected items of existing questioners related to attitudes toward

evolution theory. Then these selected items were converted to items of related to attitudes toward teaching evolution theory.

Step 2. Development of item pool

An item pool was constructed by selecting the appropriate items from the reviewed instruments according to the concern to the purpose. After all, the item pool was drafted by the authors.

Step 3. Validation of item pool

For taking formal review of specialists, draft items were sent to three specialists. Each item was placed into matrix and then asked for a response to evaluate for four areas: content validity, clearness and understandability, accuracy and distracters (Tavşancıl, 2006). After considering experts' view, numerous items were rewritten or eliminated.

Step 4. Constructing initial draft

Totally 40 items were selected from the item pool. All of the items were designed as Likert-type ranging from strongly agree to strongly disagree.

Step 5. Taking expert opinion

Initial draft of the instrument with 40 items on a five point Likert type scale was given to a group of three experts in biology, elementary science education, and educational measurement for taking their opinions about whether the selected items were valid items for assessing preservice teachers' attitudes toward teaching evolution theory. The experts were asked to oversee items in respect to their concern to purpose of the instrument, content understandability.

Step 6. Pilot testing

An initial form of the instrument revised by the experts was administrated to a total of 151 students for pilot testing. An answer sheet companied with the instrument was given to each student and then the students were asked to show their responses in this sheet. Student answer sheets were received from all departments and entered into Excel document for scoring. The data obtained from pilot study was analyzed by researchers by making use of the SPSS 11.5 statistical software programs. The results of the pilot study showed that 10 of the 40 items were not clearly understood by most of 151 students. Based upon the result of pilot study and expert suggestions, these 10 items were removed and the instrument was rearranged.

Step 7. Administration of the instrument

Final form of the instrument with 30 items was administered to 273 university students for calculating validity and reliability of the instrument. Students' responses were entered an Excel file created for further analyses.

Step 8. Calculating Validity and Reliability

The data were analyzed by means of factor analysis and reliability analysis through the use of spss 11.5. Firstly, In order to examine the factor structure, the data were analysed with principle component method. Afterwards, reliability analysis was performed for each sub-scales which is emergent after the factor analysis.

3. Result

3.1. Factor structures

For the item 1 to 30 was the correlation matrix computed and after that computation an identity matrix was emerged. As a result of the matrix, researcher saw that all variables are perfectly independent from one another (all corelation coefficients are zero) (Field, 2005).

There are two way to determine the factorability of an intercorrelation matrix. These are Bartlett's Test of Sphericity and Kaiser- Meyer-Olkin Measure of Sampling Adequacy (KMO). The Bartlett's Test of Sphericity

produced a value of 4389.943 with a significance level(<0.001), indicating the availability of the factor model. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients, and after the analysis KMO index was obtained as 0.959. High values for the KMO indicates a proper factor analysis. George and Mallery (2001). The values of both of indicators shows that factor analysis can be done for the data.

Factor analysis on TETAQ derived 23 factors with eigenvalues exceeding 1.0. These factors altogether explained 63.421% of variance of results. Scree plot shows five factors. Two of factors were represented just by one item per each factor and one factor was represented just by two item with loading higher than 0.4. Thus the rotation was necessary. Four item deleted because of their loadings in more than one factor.

Four out of 30 attitude items were deleted and the factor analysis for rotation was run again over the data set with 26 items. Varimax rotation was used. Thus, the factor analysis resulted in three independent factors with factor loadings greater than 0.4. Table 1 presents factor loadings and factor structures of the items. These three factors explained 59.432% of total variance and were named according to the common characteristics of the items loaded on the same factor.

Eigenvalues of the factors are 12.638, 1.538 and 1.277 respectively. Table 2 gives the factors, eigenvalues and total variance explained. As shown in the Table 2, Factor 1 explained %24,396 of the variance, and this proportion (>%20) is satisfactory (Reckase, 1979).

Table 1. Factor structures and loadings of the 26 items in TETAQ

Items	F1	F2	F3
Evrim bir bilim dalıdır. Bilimsel gerçeklere dayanır. Bu nedenle öğretilmelidir.	,757		
Evrim teorisi yaşamın özellikleri ile ilgili test edilebilir sonuçlar ürettiği için öğretilmelidir.	,756		
Evrim teorisi tarihi gerçeklere ve laboratuar (deneysel) verilerine dayandığı için öğretilmelidir.	,722		
Mevcut evrim teorisi, sağlam bir bilimsel metot ve araştırmanın sonucunda ortaya çıktığı için öğretilmesi de zorunludur.	,707		
Evrim dünya üzerindeki yaşamın tarihini ve yaşamın fiziksel çevreye bağımlı değişimini açıklayan bütünleştirici bir teori olduğundan öğrencilere anlatılmalıdır.	,696		
Evrim teorisi yeryüzündeki canlıların çeşitliliğini açıklayan en önemli teori olduğu için öğretilmelidir.	,678		
Evrim teorisi bilimsel olarak geçerli bir teoridir ve bu sebeple de öğretilmelidir.	,672		
Evrim teorisinin, biyolojiyi anlamak için gerekli olduğundan, öğretilmesi gerektiğini düşünüyorum.	,627		
Evrim teorisi, gözlenen yaşayan organizmaların çeşitli özelliklerine ve davranışlarına anlam vermekte olduğu için önemlidir ve öğretilmelidir.	,615		
Evrim teorisi doğa bilimleri ile ilgili sayısız bilgiyi harmanlayıp birleşmesini sağlayan bir teori olduğundan derslerde verilmelidir.	,615		
Evrim teorisini destekleyen önemli miktarda anlamlı kanıt olduğu için derslerde evrim teorisi bu kanıtlarla ile birlikte verilmelidir.	,568		
Evrim teorisi, bilimsel gözlem ve testlerle geçerliliği kanıtlanmadığından, okullarda anlatılmamalıdır.		,702	
Bugün var olan organizmalar esasında hep aynı formda (fiziksel biçimde) oldukları için, evrimsel bir bakış açısıyla bunları öğrencilere anlatmak anlamsızdır.		,682	
Evrim teorisinin bilimsel olarak test edilebilecek nitelikte olduğunu düşünmediğimden, eğitimde evrime değinilmesini doğru bulmuyorum.		,674	
Mevcut veriler evrimin gerçekten gerçekleşip gerçekleşmediğine karar vermek için açık ve yeterli olmadığından, bu teori öğretilmemelidir.		,645	
Dünyanın yaşı 20,000 yıldan az olduğu için ve bu bilgi evrim teorisi ile çeliştiği için, ilgili konular evrim bağlamında anlatılmamalıdır.		,633	
Fen bilgisi ve biyoloji derslerinde, modern insanların milyonlarca yıllık bir evrimsel sürecin ürünü oldukları anlatılmalıdır.		,617	
Evrim bilimsel olarak geçerli bir teori olmadığı için müfredata konması ve okullarda öğretilmesi doğru değildir.		,577	
Günümüzde var olan organizmalar milyonlarca yıllık evrimsel bir sürecin sonucu olduğuna inandığım için biyoloji konularını bu perspektifte anlatırım.		,477	
Evrim teorisini anlatırsam kendimle çelişirim.			,718
Bilim insanlarının çoğu, evrimin gerçekleşip gerçekleşmediğine dair şüphelere sahiptir. Şüpheli bir bilgiyi de öğretmek doğru değildir.			,695
Evrim teorisini anlatmanın çocukların kafasını daha da karıştıracağını düşünüyorum. Bu yüzden öğretilmemelidir.			,667

Evrim teorisinin gündelik yaşamda uygulaması olmadığından öğretilmesinin mantığı yoktur.	,656
Birkaç istisna ile birlikte, yeryüzündeki organizmalar neredeyse aynı zamanda oluşmaya başladılar. Bu nedenle evrim teorisini öğretmek anlamlı değildir.	,584
Evrim teorisi öğretiminin biyoloji anlamak için gerekli olmadığını düşünüyorum.	,566
Evrim teorisi yaratılış teorisi ile ilgili açıklamalarla çeliştiği için doğru olamaz. Bu sebeple de ilk ve orta öğretim okullarında öğretilmemelidir.	,530

Table 2. Factor names, eigenvalues and variance of factors

Factor Names		Eigenvalues	% of Variance Explained
Evrim ve Evrim Teorisi'nin öğretilme gerekçeleri	Factor1	12,638	24,396
Evrim Teorisinin Kanıt Yetersizliğinden dolayı öğretilmemesi	Factor2	1,538	18,380
Çelişkilerden Dolayı Evrim Teorisinin Öğretilmemesi	Factor3	1,277	16,656

3.2. Reliability and discriminate validity of emerged factors

Tablo 3. Shows name of factors, number of items included in and reliability value of each factor

Factor Names	Number of Item included in the Factors	Reliability (α)
Factor1. Evrim ve Evrim Teorisi'nin öğretilme gerekçeleri	11	0.938
Factor2. Evrim Teorisinin Kanıt Yetersizliğinden dolayı öğretilmemesi	8	0.890
Factor3. Çelişkilerden Dolayı Evrim Teorisinin Öğretilmemesi	7	0.856

For all of three factors, the high values of the alpha coefficients suggest that the instrument displayed adequate internal consistency and low mean values of correlation coefficients between each scale provided the discriminant validity of the scales. According to these results, the instrument is strongly internally consistent and reliable for interpreting attitudes of teaching evolution theory among preservice teachers.

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